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## Radius of Curvature

The radius of curvature is given by

$$R \equiv \frac{1}{\kappa}, \quad (1)$$

where  $\kappa$  is the curvature. At a given point on a curve,  $R$  is the radius of the osculating circle. The symbol  $\rho$  is sometimes used instead of  $R$  to denote the radius of curvature.

Let  $x$  and  $y$  be given parametrically by

$$x = x(t) \quad (2)$$

$$y = y(t), \quad (3)$$

then

$$R = \frac{(x'^2 + y'^2)^{3/2}}{x'y'' - y'x''}, \quad (4)$$

where  $x' = dx/dt$  and  $y' = dy/dt$ . Similarly, if the curve is written in the form  $y = f(x)$ , then the radius of curvature is given by

$$R = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}. \quad (5)$$

In polar coordinates  $r = r(\theta)$ , the radius of curvature is given by

$$R = \frac{(r^2 + r_\theta^2)^{3/2}}{r^2 + 2r_\theta^2 - rr_{\theta\theta}}, \quad (6)$$

where  $r_\theta = dr/d\theta$  (Gray 1997, p. 89).

**SEE ALSO:** Bend, Curvature, Osculating Circle, Radius of Gyration, Radius of Torsion, Torsion

## References

Gray, A. *Modern Differential Geometry of Curves and Surfaces with Mathematica, 2nd ed.* Boca